Hidajat, M., McElvenny, D. M., Ritchie, P., Darnton, A., Mueller, W., Van Tongeren, M., Agius, R. M., Cherrie, J. W., & De Vocht, F. (2019). Healthy worker effects explain differences in internal and external comparisons in a rubber industry cohort study. *Occupational and Environmental Medicine*, *76*(10), 781. [oemed-2019-106083]. https://doi.org/10.1136/oemed-2019-106083

Peer reviewed version

Link to published version (if available):
10.1136/oemed-2019-106083

Healthy-worker effects explain differences internal and external comparisons in a rubber industry cohort study.

Hidajat M[1], McElvenny DM[2], Ritchie P[2], Darnton A[3], Mueller W[2], van Tongeren M[4], Agius RM[4], Cherrie JW[2,5], de Vocht F[1].

[1] Population Health Sciences, Bristol Medical School, University of Bristol, Bristol, UK.

[2] Research Division, Institute of Occupational Medicine, Edinburgh, UK.

[3] Statistics and Epidemiology Unit, Health and Safety Executive, Bootle, UK.

[4] Centre for Occupational and Environmental Health, Centre for Epidemiology, School of Health Sciences, The University of Manchester, Manchester, UK.

[5] Institute of Biological Chemistry, Biophysics and Bioengineering, Heriot Watt University, Edinburgh, UK.

In his letter, Professor Sorahan [1] poses an important question about our paper [2], namely whether the results indicate that occupational exposures to agents such as rubber dust, rubber fumes, and nitrosamines in the rubber industry are associated with increased risk of mortality from cancers of the bladder, lung, stomach, oesophagus, prostate, larynx, brain, pancreas, liver, and lymphatic and haematopoietic tissue. Sorahan argues that causation does not seem to be warranted since results from a second study using the same study cohort indicate no increased mortality risks from these cancers when compared to the general population [3]. However, internal analyses, which make selection effects, such as the healthy worker effect [4], much less likely are a more appropriate method to assess causality than analyses that compare risk in an industrial cohort with the general population. Many occupational populations differ in their mortality rates from the general population, even after standardization, because of selection

effects on health status at hire and subsequent healthy worker survivor effects that have both been well described in the literature. These effects differ between industries and specific exposures [5], but often result in SMRs under-estimating the true effects on mortality from occupational exposures in industrial cohorts wherever a causal association exists [6], as well as in cohort studies more generally [7]. Therefore, it is perfectly possible, as indeed these data also show, and not necessarily conflicting that an association between a specific exposure and risk of premature mortality exists within an occupational cohort while it is not identified in comparison with the general population [6].

It is important to acknowledge that Professor Sorahan's main concern relates to inferences made with respect to the contemporary rubber industry, whereas our study relates to historic exposures. In this respect we would like to draw attention to the last sentence in our paper, which indicates that there are "…implications for the industry today where occupational exposures to N-nitrosamines continues to persist, although at greatly reduced levels compared with several decades ago."

References

1. Sorahan T. Conflicting findings from a rubber industry cohort study: What is the explanation?. *Occup Environ Med* 2019; in press

2. Hidajat M, McElvenny DM, Titchie P, Darnton A, Mueller W, van Tongeren M, Agius RM, Cherrie JW, de Vocht F. Lifetime exposure to rubber dusts, fumes and N-nitrosamines and cancer mortality in a cohort of British rubber workers with 49 years follow-up. *Occup Environ Med* 2019; 76: 250-258

3. McElvenny DM, Mueller W, Ritchie P, Cherrie JW, Hidajat M, Darnton AJ, Agius RM, de Vocht F. British rubber and cable industry cohort: 49-year mortality follow-up. *Occup Environ Med* 2018; 75: 848-855

4. Shah, S. Healthy worker effect phenomenon. *Indian J Occup Environ Med* 2009; 13: 77–79.

5. Baillargeon J. Characteristics of the healthy worker effect. *Occup Med* 2001; 16: 359-66.

6. Park RM, Maizlish NA, Punnett L, Moure-Eraso R, Silverstein MA. A comparison of PMRs and SMRs as Estimators of Occupational Mortality. *Epidemiology* 1991; 2: 49-59

7. Card TR, Solaymani-Dodaran M, Hubbard R, Logan RFA, West J. Is an internal comparison better than using national data when estimating mortality in longitudinal studies? *J Epidemiol Community Health* 2006; 60: 819-821.